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Demonstration Bulletin

Subsurface Volatilization and Ventilation System®

Brown & Root Environmental

Technology Description: The Subsurface Volatilization and Ventilation System (SVVS®) is an in-situ vacuum extraction/air sparging and bioremediation technology for the treatment of subsurface organic contamination in soil and groundwater. The technology, developed by Billings and Associates, Inc., and operated under a licensing agreement by Brown & Root Environmental (formerly Halliburton NUS Corporation), utilizes vapor extraction and biostimulation to remove and destroy organic contaminants from the subsurface. Vapor extraction removes the easily strippable volatile components from the soil and/or groundwater. This removal mechanism is dominant during the early phases of the remediation. Biostimulation processes dominate the later phases of the remediation and are used to accelerate the in-situ destruction of organic compounds in the soil and groundwater. The developer claims that remediation using the combination of vapor extraction and biostimulation is more rapid than the use of biostimulation alone, while generating lower quantities of volatile organics than vapor extraction technologies. In addition, SVVS® can remediate contaminants that would not be remediated by vapor extraction alone (chemicals with lower volatilities and/or chemicals that are tightly sorbed). These benefits translate into lower costs and faster remediations.

The technology consists of a network of injection and extraction wells plumbed to one or more compressors or vacuum pumps, respectively. The vacuum pumps create the negative pressure to extract contaminant vapors. Air compressors simultaneously create positive pressures across the treatment area to deliver oxygen for enhanced aerobic biodegradation. The system is maintained at a vapor control unit that houses pumps, control valves, gauges, and other process control hardware.

Depending on site conditions, subsurface vaporization can be enhanced via the injection of heated air. In addition, separate valves may be installed at the manifold of individual reactor lines or on individual well points for better control of air flow and pressures in the treatment area. Depending on groundwater depths and fluctuations, horizontal vacuum screens, "stubbed" screens, or multiple-depth completions can be applied. The system designed for a site is dynamic, allowing positive and negative air flow to be shifted to different locations in the subsurface so as to focus and concentrate remedial stresses in specific areas. Negative pressure is maintained at a suitable level to prevent the escape of vapors from the treatment area. If air quality permits require emission control, volatile organic compounds can be treated by a patent-pending biological filter that uses indigenous microbes from the site.

Waste Applicability: According to the developer, the SVVS® is applicable to sites contaminated with gasoline, diesel fuels, and other hydrocarbons, including halogenated compounds. The developer claims that the SVVS® is very effective on benzene, toluene, ethylbenzene, and xylene (BTEX) contamination. The technology can be applied to contaminated soil, sludges, free-phase hydrocarbon product, and groundwater.

Demonstration Results: The SVVS® technology was demonstrated at the Electro-Voice, Incorporated, (EV) facility in Buchanan, MI, between April 1993 and April 1994. Historical activities at the EV facility included painting, electroplating, and assembling components associated with the manufacture of audio equipment. In 1964, EV implemented an automated painting system, and a dry well was installed to handle some of the liquid wastes generated from the paint shop. A remedial investigation discovered a sludge-like material beneath the dry well area contaminated with aromatic hydrocarbons and halogenated and non-halogenated volatile and semivolatile compounds. Some of these organic contaminants have migrated to underlying strata.

An SVVS® was installed at the site, based on the concentration and pattern of contaminants in the vadose zone. The system consisted of three separately valved rows of alternating vacuum extraction and air injection wells (Figure 1). There are eleven vacuum extraction wells and ten air injection wells, each of which are valved independently for optimum system flexibility and air flow control.

The primary objective of the SITE Demonstration was to determine the effectiveness of the SVVS® technology in reducing volatile organic contamination in the vadose zone. Based on this objective, the developer claimed that its technology would reduce the average contamination of seven target analytes in the vadose zone by 30% over a one-year period.

The seven analytes chosen for the study included benzene, toluene, ethylbenzene, xylenes, tetrachloroethene, trichloroethene, and 1,1-dichloroethene. Additional analytes from the soil, groundwater, and extracted air streams were collected to further assess the performance and effectiveness of the SVVS® technology. These assessments included determining the relative contribution of biodegradation versus vapor extraction, and evaluating

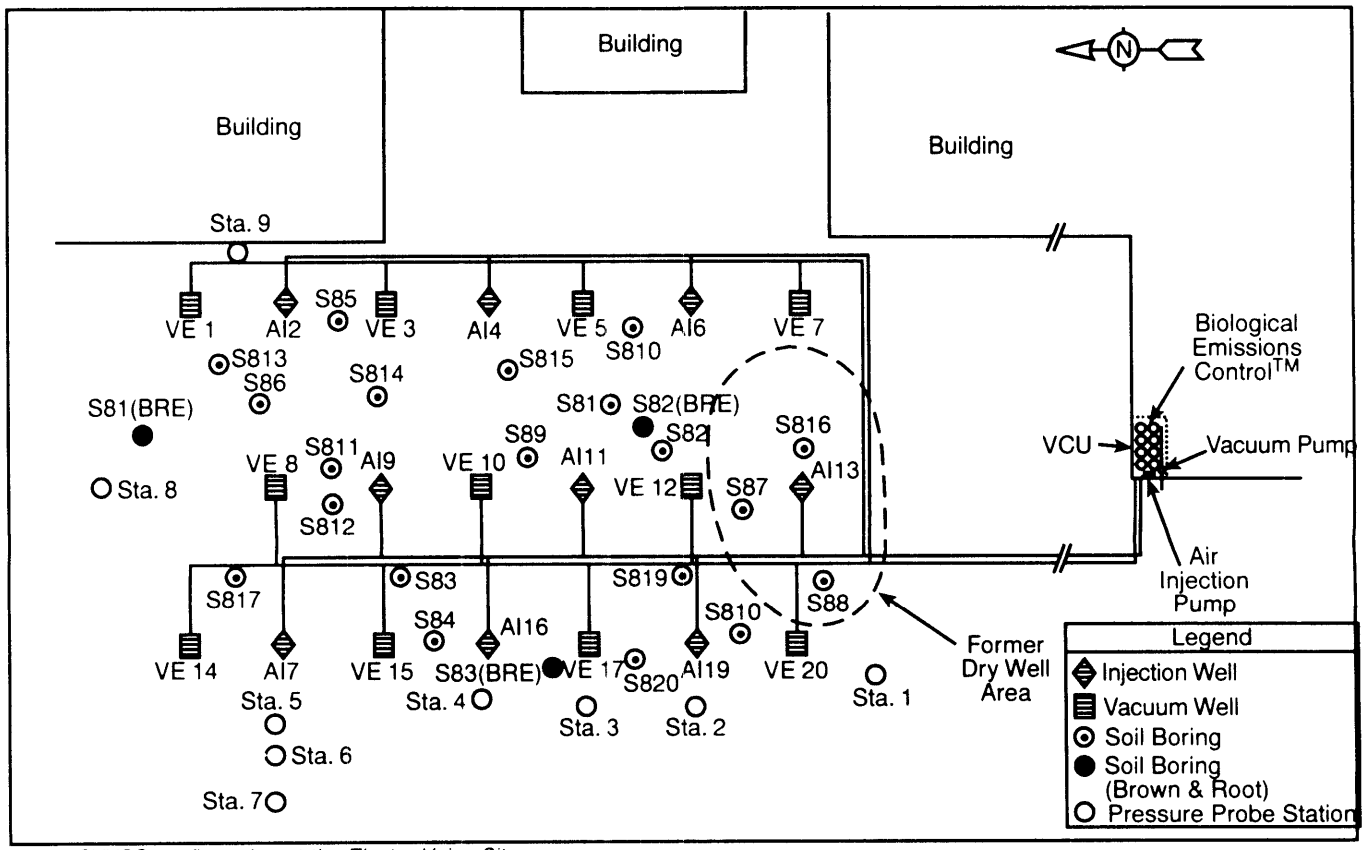

Figure 1. *SVVS® configuration at the Electro-Voice Site.*

physical and chemical soil properties that may affect the technology.

The developer's claims were evaluated by collecting and analyzing soil samples from several locations before implementation of the technology and after one year of operation. Changes in the concentration of the seven target analytes were compared between the two sampling events. In addition to the soil samples, volatile organics were measured from the vapor extraction wells. Shutdown tests were used to determine the magnitude and spatial variability of biodegradation.

Preliminary results from the SVVS® technology demonstration follow:

- The SVVS® technology greatly exceeded the developer's claim for a 30% reduction in the seven target analytes over a one-year period. Data indicated that the overall reductions as determined from individual boreholes, ranged from 71% to over 99%.
- As predicted by the developer, the early phase of the remediation was characterized by higher concentrations of volatile organics in the extracted vapor stream.
- The shutdown tests indicate that the technology stimulated biodegradative processes at the site.

An Innovative Technology Evaluation Report (ITER) describing the complete demonstration will be available in early 1995.

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